Fundamentals of Manufacturing Processes
Dr. D. K. Dwivedi
Department of Mechanical & Industrial Engineering
Indian Institute of Technology, Roorkee

Lecture – 12
Casting: Terminology

Hello, I welcome you all in this presentation related with the subject fundamentals of the manufacturing processes. And we are talking about the casting process. And today we will be talking about the commonly used terms for the casting process. So, as you know the casting is one of the fastest route to get the desired size and shape; just by melting the material and pouring it into the mould so that after the solidification we can get the desired casting.

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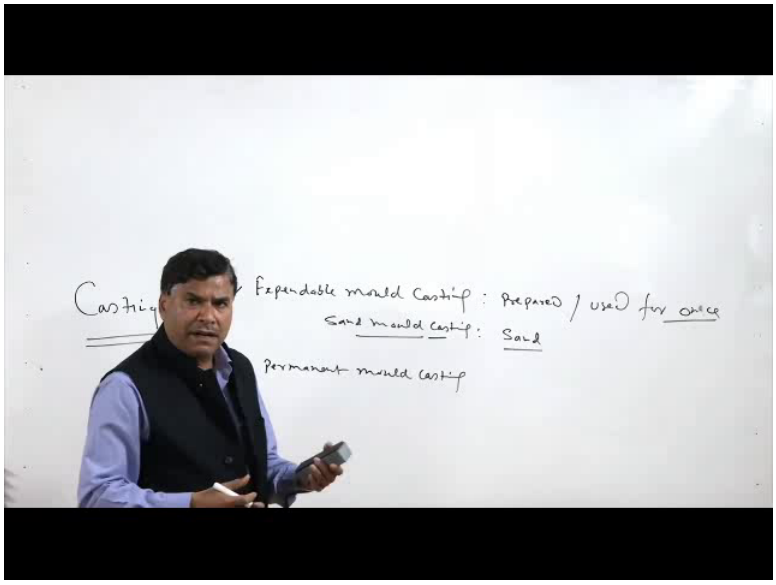

So, but here the mould is very important component, because the cavity; mould is nothing just a cavity where in molten metal is a field in to get the desired component after the solidification of the molten metal, but for the preparation of the mould and there are number of structural elements and number of components which are used in the moulding and casting process.

So, we will try to familiarize with the commonly used in terms related with the casting. So, normally the sand mould casting process is one of the most commonly used to process for; like say for job shops or for a like a small volume production and especially

like say the complicated shape products are for automatic industry are extremely are commonly used to produced commonly produced using the a sand mould casting process.

So, as far as the moulding is concerned, there the casting process is that grouped under the two broad headings; one is expendable mould casting and another is permanent mould casting. So, in case of the expendable mould casting, these are prepared and used for once only means one casting is made then these need to be destroyed and again another mould is to be prepared for making the another casting.

So, sand mould casting is one of the expendable mould casting method; wherein the sand is used for making the mould. And every time sand mould is required to be prepared for making the casting. And these are broken once the casting is ready after the solidification the mould is broken. While in case of the permanent mould casting this can be used repeatedly repeated use is a allowed and the number of castings can be made using the permanent mould castings and these numbers can be very high maybe like say 100 to 10000 or even 1 lakh number of the casting. So, depending upon the volume of the production the metallic moulds are other types of the moulds are or permanent moulds are prepared. Permanent moulds are mostly made of the metals.

So, they are different processes which use the metallic mould and among these is one of the commonly known as a the die casting or this is also known as the permanent mould casting and others like hot die; these are the variance of the die casting. Die casting normally; the solidification occurs under the gravitational force condition, and here in the hot die casting and cold die casting process the external pressure is applied. So, under the influence of the external pressure the solid feeding as well as the solidification of the molten metal is achieved.

So, the permanent mould casting is justified for a large volume production as well as here good quality or good quality surface a finished as well as the closed dimensional tolerance is required while for other cases where the volume of the production to be done is limited. And you can see the final size and shape can be realized using subsequent machining processes then sand mould casting is more economically justified.

So, how the permanent how the sand mould is prepared, and what are the common terms related with the sand mould casting that is what we will try to see. So, it basically uses the metallic flasks.

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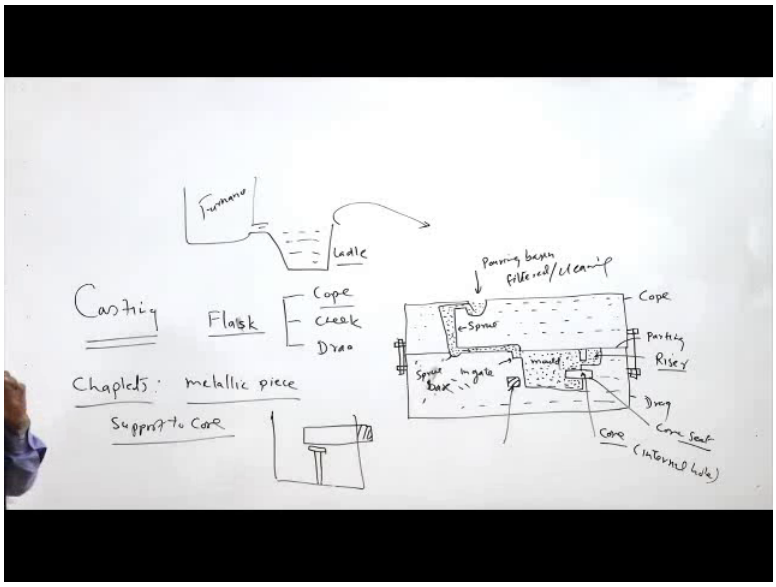

It uses the metallic flask for holding the sand. So, there are a three types of the flasks depending upon the geometry or the size of the castings to be made or the mould to be made, we can use the flask there is a cope and there is a cheek and the drag.

So, like say these are; the flask are nothing just they are like a rectangular shape thin walled, boxes which are open from both the sides. So, you can say in the top it will look like this and in front view it will look like this. So, the flasks these are the thin walled is steel flasks, where one side there may be a joint also normally these have like a the arrangement for alignment of the flasks like a pin and the hole kind of thing we can see. So, these are used for the two purposes; one is alignment, and another is holding the flasks together.

So, when two or more number of the flasks are used the one these flasks are kept one over other and they need to be aligned properly and help properly. So, that the shape of the casting shape of the mould can be maintained, and for this purpose these slots and the holes are made. So, that the pin can be inserted to in order to make them properly aligned and held in line.

So, like say the flask one flask in front if you see the flask like this. One flask there is a another flask and third flask. If you are using three flasks, then the one flask which is used at the top is called cope and the one which is used at the bottom is called drag and the one which is kept at the middle is termed as cheek.

So, how are it is common to use the two flasks, which are termed as cope and drag, but for the large and are the complicated shape castings even third flask termed as cheek is also used. So, if you see here like say this is the flask top flask and where these two flasks meet each other that forms the parting line.

So, here let us say these flasks are actually full of the sand like this. And then and these two flasks both will be meeting. So, the line along which the two flasks meet is called the parting line, this is cope and this is drag. So, what we try to do here we will be making the different parts and the features which are normally used in the moulding.

So, these are achieved through the packing of the various components, during the sand moulding. So, here first of all we will try to prepared the pouring basin. So, like this is open and conical, so this is pouring basin. We try to feed the molten metal with the help of the ladle like say this is the furnace. So, molten metal is stabbed from the furnace into the ladle and this ladle is a used to transport the molten metal to the mould. So, the molten metal from the ladle is poured into the pouring basin. So, molten metal will be coming here and then pouring basin is design in such a way that it filters the impurities.

So, pouring basin is design is designed in such a way that the impurities are filtered. So, like the oxides, slag, dross, etcetera is filtered and thereafter the molten metal will be flowing into the sprue. So, sprue after the pouring basin the molten metal goes into the sprue. And then it reaches its changes its direction of the flow at the spure. So, this is the sprue slightly reducing in cross section in the sprue molten metal will be flowing at a higher and higher velocity at is as it moves down and here at the sprue at the bottom of the sprue we have sprue base.

So, here there will be change in direction of the molten metal and then after reaching to the sprue base it flows into the runner. So, this reducing cross sectional member is sprue; this is made of the reducing cross sectional, so that cross sectional area. So, that air aspiration is reduced and the; it is always full of the molten metal. So, the air is not sucked into the molten metal and so, it remains clean and the gases are not gases do not

get mixed up with the molten metal. And after reaching to the sprue base, molten metal starts flowing into the runner. Runner is design in such way that it also helps to prevent the entry of the light metals like oxides impurities and slag dross and it is stopped at the top level and entry of the molten metal takes place through this region.

So, this region where from molten metal enters into the mould is termed as this a cavity wave from molten metal enters into the mould is called in gate. And this cavity according to this shape of the casting is made is termed as mould to take care of the shrinkage of the molten metal in course of the liquid to the solid state transformation risers arrangement for the riser is made. So, riser next to the mould is placed in such a way that it can feed the molten metal to the cavity as per the requirements.

So, whenever we feed the molten metal to the mould. So, after filling the mould after filling of the molten metal into the mould molten metal enters into the riser. So, this riser supplies the molten metal at the time, when shrinkage of the liquid shrinkage of the metal on transformation from the liquid state to the solid state takes place.

So, basically the role of the riser is to supply the liquid metal to the mould, when this shrinkage due to the solid liquid to solid state transformation occurs. And if any internal cavity is to be made, then that modification is also made here; like say in the internal cavity of particular shape is needed here then we put one core. So, this is the core. So, this is the region where molten metal will not be able to enter due to the presence of core. So, this additional feature you can call core is used for generating the internal holes or any other a special geometry.

So, for this purpose the core is used, and core is kept in the mould sand mould. So, we can say that portion is called core seat, where the core will be kept in the mould and this is the riser. So, these are the various terms this is the sprue base in gate pouring basin will be doing filtration or cleaning of the liquid metal, cope, drag, parting line and in order to hold the cope and drag with the each other and normally the pins are used. So, that they the pins will be keeping helping them to keep aligned; as well as hold them together.

So, that the suppression of the mould due to the metallostatic pressure, after the feeding of the liquid metal to the mould is avoided. So, the moulds are the moulds like cope and drag; the flasks are aligned. So, that the cavity maintains it is a shape as well as the

suppression of the flasks at the parting line is avoided, under the metallostatic pressure of the liquid metal with due to the holding of the flasks with the help of the lock prince or a nut and bolts.

So, that is the kind of arrangement which is used normally a very detachable locking arrangement is used in the flasks in order to avoid these suppression of the flasks. So, let me see if something is left here. So, in addition to this some more words and the common terms are used related with the casting; like one is chills: chills are nothing just the these are the metallic pieces kept in the mould like say the chills we may place in such a way like this is the chill which has been placed in the mould.

So, purpose of this is these are the metallic pieces. So, purpose is to increase the cooling rate selectively; cooling rate at specific location selectively; purpose of this selectively. So, purpose of this is to have the; so cooling rate is increased selectively at a specific location. So, as to have desired temperature gradient and the purpose of having the desired the temperature gradient is to ensure that the directional solidification is achieved. So, this is primarily purpose of the purpose of using the chills. So, chills are the metallic pieces and they will replaced suitability in such a way that the directional solidification is achieved. These do not from the part of the casting and then other common term which is used is the chaplet. Chaplet is used chaplet is a kind of the metallic piece, which is used to support the core in the cavity. So, like say this is the cavity or this is the mould, and we want to support the core inside the mould.

So, here seat is a limited, and we know that if the site if over (Refer Time: 20:47) is this must then the mould will have tendency to settle down. So, all to get fractured so, in order to provide suitable support the metallic pieces like this are kept in the mould. So, that they can provide the support and the position of the mould is not disturbed; when the pouring of the molten metal is done into the casting.

So, basically the chaplets provide support to the core. So, that it does not break or a it is position is not disturbed in the casting. So, that we can have the internal cavities at the desired location; most it is expected that when the molten metal is poured.

So, the surface of the chaplet will be under the influence of the heat of the molten metal the surface of the chaplet will be meltdown and it will form the part of the casting. So, the size of the chaplet becomes important, because if it is too heavy; then it will extract

lot of heat and the melting of the surface of the chaplet may not be facilitated. And if it is too thin; then the chaplet may melt completely as soon as the molten metal is poured into the casting, and in that case it may not be able to provide the support to the core as the requested. So, that required function is not achieved.

So, these are common terms which are used related with the casting. And we will try to see this using the PPT to have the more clarity in terms of the diagram which is used.

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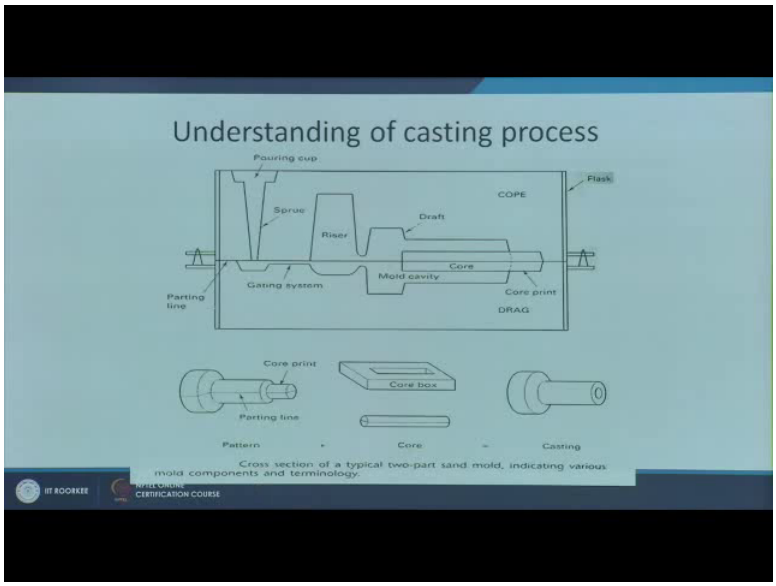

So, like say here these are the two flasks; this is the cope upper one and this is the drag lower one and the two flasks are aligned with the help of these two like pins one side another side. So, these two pins will be keeping them in particular position aligned; as well as these can be tightened in order to avoid the suppression of the flask; this is the pouring basin here in this kind of design there will not be any kind of the filtration of the impurities, but the kind of design which are made in that case the filtration is also facilitated.

So, we can make the pouring basin in such a way that the impurities can be separated. The impurities like dross or oxides or inclusions etcetera; impurities can be filtered out and this is the sprue and this is sprue base. And the parting line where the two are getting two are meeting and this is the runner through which molten metal flowing after passing through the sprue base. And here in this design they have made riser here itself this will be filled in after the mould cavity that is this one is filled. So, mould cavity this entire

zone is the mould cavity here this is the in gate and the core is a provided in order to make the internal hole in this casting and here the seat which is provided for positioning the core is the core seat or the core print. So, this is made. So, you we can say the internal holes are made with the help of the cores.

So, this entire system right from the pouring basin to sprue base runner and the mould cavity riser etcetera; all these form the part of the getting system. And this is to be designed properly. So, that the molten metal can be fed into the casting in the minimum possible time, and the suitable directional solidification is also achieved. So, that the casting is free from the defect and like the issues related with the shrinkage and others can be taken care of effectively.

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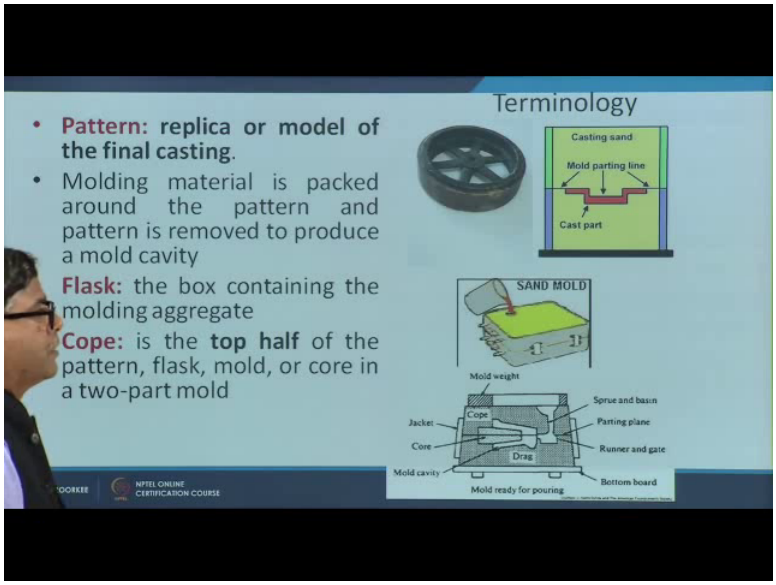

So, now we will see other terms which are related with this here their like say the pattern all though have not talked about the pattern. So, far; so pattern is a like the mould cavity is the cavity which is which is having the shape of the casting to be made say this is the cavity and the shape of the casting to be made is a almost the same type like this.

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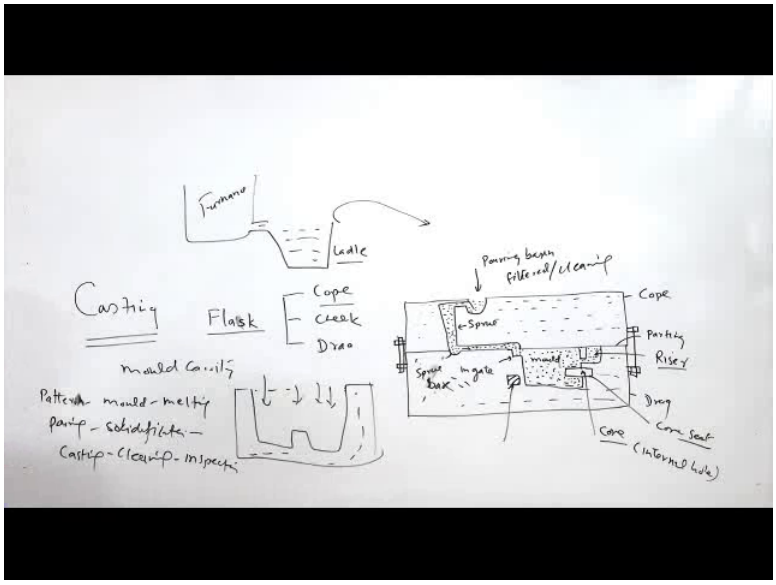

So, if this component is to be made, then the cavity of this kind is to be prepared. So, and this will be filled in the molten metal. So, in order to prepare this cavity of the sand mould, then we need to first of all make a pattern is nothing just a model or replica of the product or casting to be made.

So, but the shape may be same, but it is different in terms of the it is different in terms of the dimensions, and what these; why; what are the factors which lead to have the difference in the dimensions about that we will talk now. So, this pattern actually the first thing which is a done for in the casting process. First of all; we prepare the pattern and then using pattern we make the mould, and once the mould is ready we go for melting of the material and once the material is melted the pouring of the molten metal is done into the mould. There after solidification will be taking place and after the solidification the cast casting is taken out. And then cleaning is done like fed fettling tumbling sandblasting etcetera and then we inspect the casting whether; it required casting with the required features and dimensions and the free from any defect has been produced or not.

So, the preparation of the pattern is the first step in the casting and. So, the pattern is used for making the mould.

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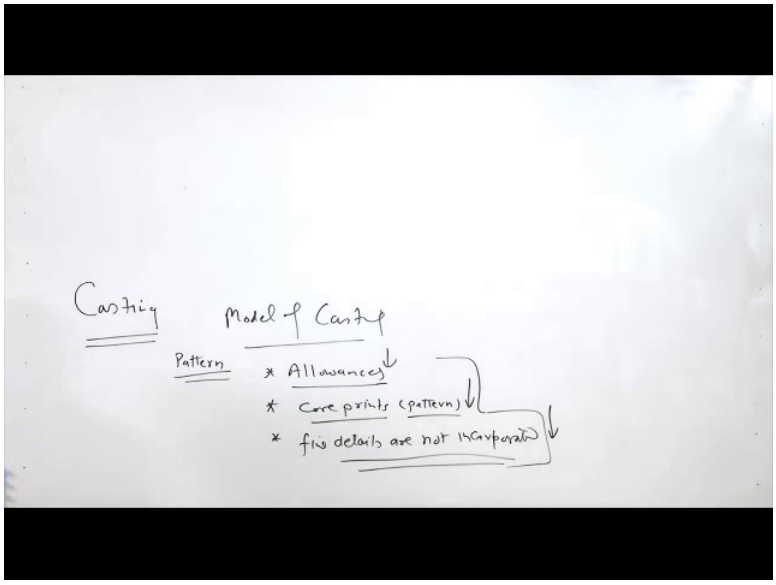

So, the patterns actually different differs in terms of the dimensions from a casting to be made due to the two regions it is a model having the same geometrical features, but different in dimensions.

So, the region for the difference in dimensions is that; we need to provide certain allowances. So, that it is, so that the required subsequent operations can be carried out on the casting, which has been prepared and which has been made. So, in addition; to the in addition to the allowances provision of the allowances, we try to make the core prints also in the pattern. So, pattern will have the different size and shape due to the core print core print feature is incorporated in the pattern itself allowances, because of the allowances the dimensions become different and some the fine details find details are not incorporated in the incorporated in the pattern, because if the details are very fine like half mm thin section of the of the greater length is to be produced. Then, probably it will be better to do machine it out or some slot of the half mm thickness is to be made of the greater length of the high. So, means high aspect ratio slot is to be made then it will this will be omitted from the pattern and better it will be made using the machining process. So, after the casting will it will be machined out.

So, fine details are not incorporated because these otherwise; you will be leading to the lack of feeling or the defective casting. So, we something which cannot be produced effectively efficiently using the casting route means some of the geometrical features if they cannot be made using the casting route in the casting or in the component, then they will be produced by the machining.

So, these details are also omitted or these are not incorporated in the pattern. So, basically it is a model of the casting with these differences we have allowances we make the arrangement for the core paints. So, that the seat for the core can be made and then it will also have the means the final details related with the products will also not be incorporated in the pattern.

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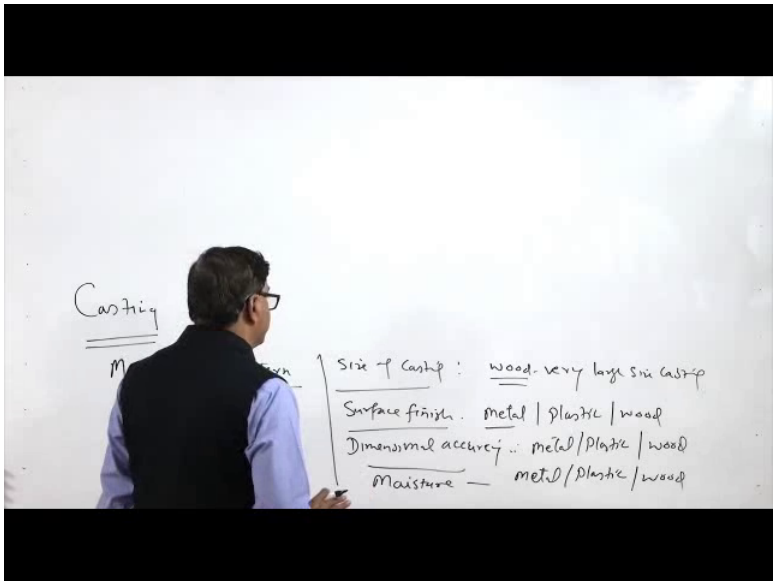

What we can use for making the pattern that is another important thing because this is the first step for making the mould is to prepare the pattern first. So, we need to talk about the materials for pattern. What material can be used for making the pattern? So, depending upon their certain factors which will govern the selection of the material and these factors include; the size of the casting. Like for very large size casting we prefer to go for the wood only for wood for very large size casting, because metallic patterns will not be easy to handle for preparing the mould. So, we prefer for the wood otherwise; like say the surface finish; if some of the components to be used in as cast condition, then better to consider the surface finish.

So, surface finish is a another component; here like say if the good finish is desired then metallic pattern is preferred or the plastics are used otherwise; a for a reasonably good finish we prefer the wood and then dimensional accuracy which is desired. So, metal metals of metals and plastics of our good dimensional accuracy then the wood.

So, this you can say in the order of the preference for the finish as well as the dimensional accuracy of the material to be used. Then there are certain additional features; like the conditions in which it is to be used like a the moisture if the environment where cust where patterns are to be used is very moist then wood is not preferred, it is more preferred to use the metal and plastic mould over the over the wood patterns.

So, considering these points in mind these are the factors which are normally considered for the purpose of the selection of the pattern material. Now we will talk about all three materials which are used for making the pattern and when they are preferred.

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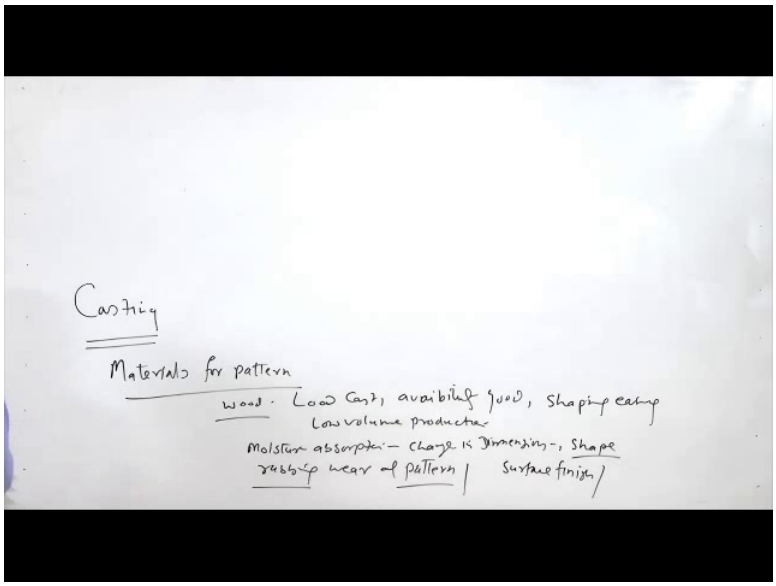

So, if we talk of the wood. Wood is very easily available it is very low cost, it is low cost availability is good and; shaping is easy any shape can be shaping is easy any shape can be made.

So, its and because of these features is good for the low volume production; means when few castings are to be made then the wooden pattern can be used, but there are issues like a the woods absorb the moisture. So, moisture absorption leads to the change in dimensions. So, once there is a change in dimension, then it will be leading to the change in size of the mould cavity and which will lead to the having the dimensions of the casting which are not desired. So, change in dimensions or even due to the rapid; the shape is also modified. And due to the rubbing with the sand, the wearing rubbing with

the sand leads to the wear of the pattern. So, that will also be leading to the loss of the dimensions of the pattern.

So, these are the undesirable feature. So, we can say that the a stability in terms of the dimensions and the shape of the wood pattern is poor also the surface finish and the dimensional accuracy which is achieved in the casting is poor in case of the patterns which are made of the wood. So, is still it is good to make the patterns of the wood for the low volume production for the low cost production, but when the volume of the production is high, then really metallic mould patterns are preferred.

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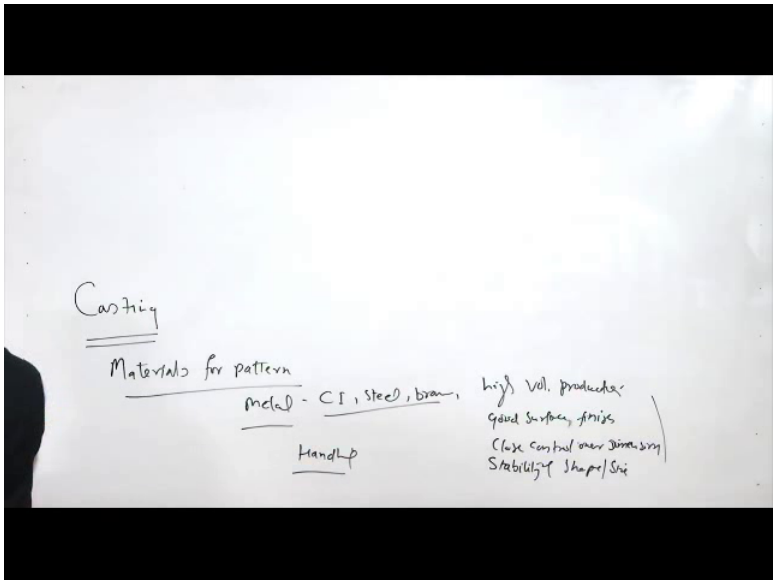

So, among the metals these are like say we can use a cast iron, we can use a steel, we can use brass for this purpose. These are good for the high volume production also results in the good surface finish and very close control over dimensions.

So, these are the very good sides and the stability of shape size. And there is no moisture absorption the wear distance is also these are not the problematic. The problem is handling so, because of high density handling and handling is since these are heavy. So, handling will be difficult; it will be leading to the more fatigue to the operators of the person, who is doing the moulding.

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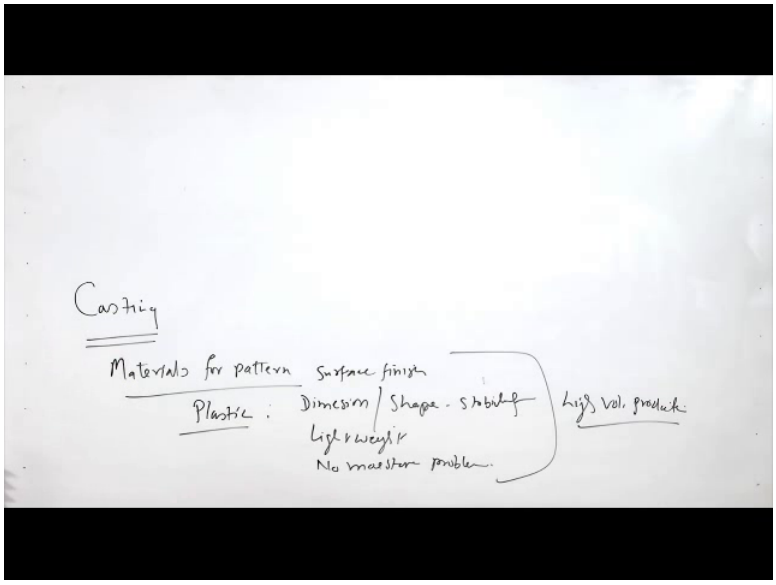

On the other hand; if we consider the plastics are good in that way, like the dimensions of the pattern shape both having good stability. So, this is very good side these are also having low weight. So, light in weight which was the negative point of the metallic pattern as well as no moisture absorption problem, no moisture problem dimensional stability is good surface finish is good. So, the surface finish achieve the surface finish of the mould surface is produced by the plastic patterns is also good. So, these are used for the high volume production high volume production.

So, here, so these are the materials which are used for making the pattern. So, here know I will conclude this presentation; in this presentation I have talked about the commonly used terms in the casting process and also the patterns what is the pattern, and what are the different materials which are used for making the pattern. And how to select the pattern for the different conditions like the dimensional requirements surface finish requirement and the working conditions the volume of the production which is required. So, all these factors need to be considered while selecting the material for the pattern if the material selected properly then probably will be able to have the castings of the desired quality and characteristics that to economically.

Thank you for your attention.